

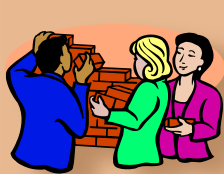
# US 95 MSAT Study: Example



View from roof of science building at Western High School; monitoring trailer and US 95 in foreground

# Summary: US 95 MSAT Project Example

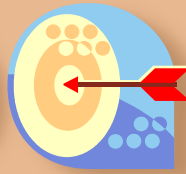
- US 95 mobile source air toxics (MSAT) project (Nevada Dept. of Transportation, NDOT)
- Example of community-scale study
- Review each of the steps below and how they influenced the final results and mitigation actions



Establish a stakeholder group



Assess issues of concern



Set project goals



Design full project



Collect and QC data



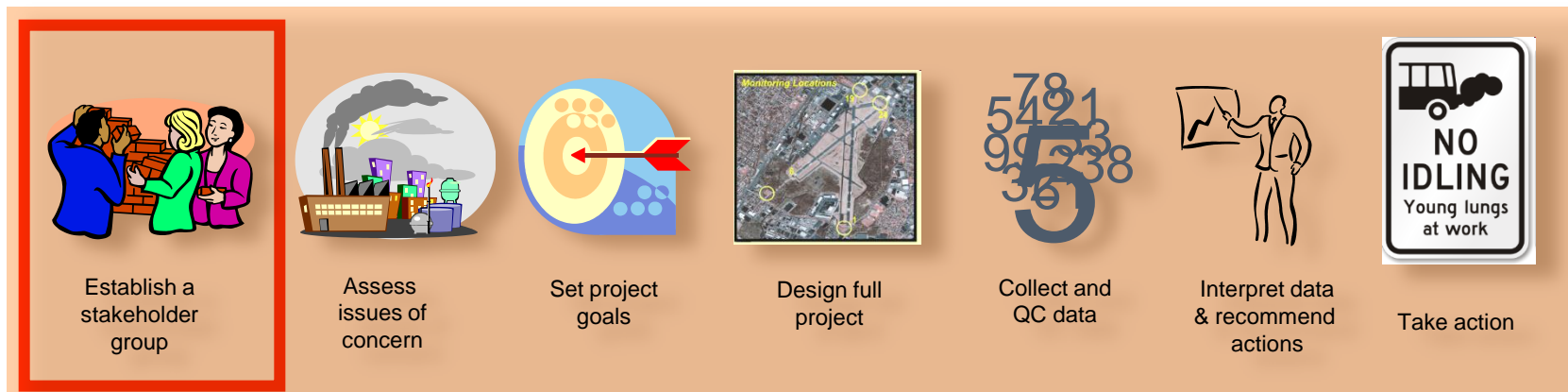
Interpret data & recommend actions



Take action

# Establish a Stakeholder Group

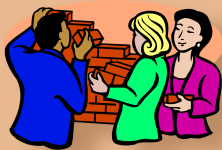
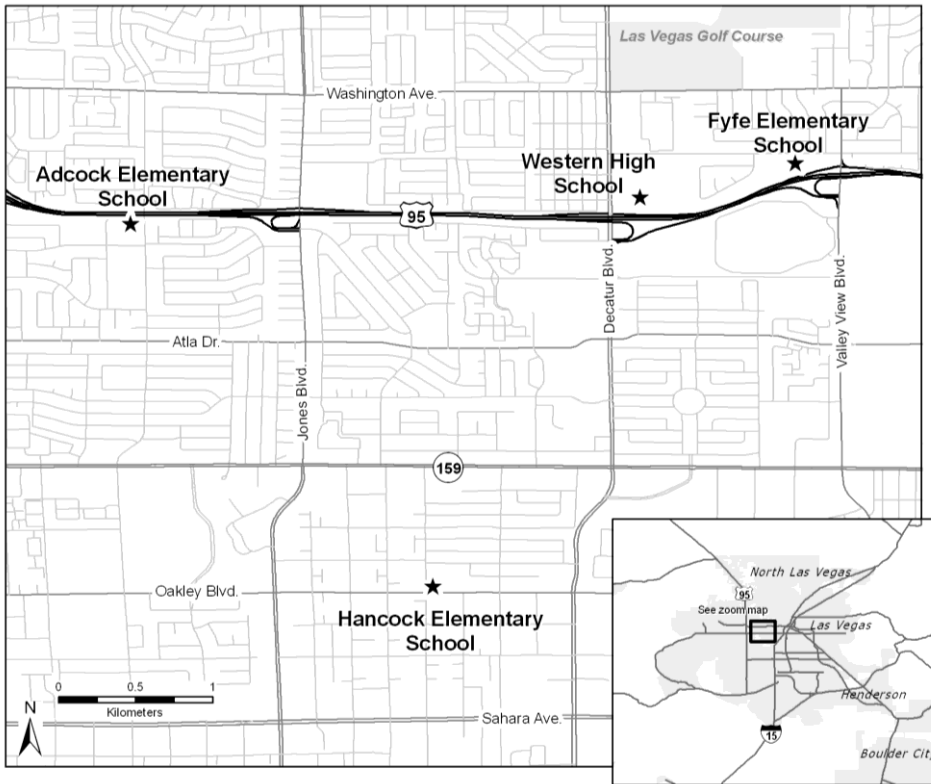
- A Court Settlement Agreement was reached between the Sierra Club and NDOT/Federal Highway Administration (FHWA) regarding urban freeway expansion where three schools are adjacent to the roadway.
- Both mitigation and monitoring were required to reduce and assess student exposure.
  - MSAT monitoring study at schools (this study)
  - Filtration added to heating, ventilation, and cooling (HVAC) systems at schools
  - Bus retrofit program
  - Bus idling education
  - FHWA gradient study (with EPA)



# Assess Issues of Concern

Expansion of US 95 in Las Vegas, Nevada, where three adjacent schools were located within a few hundred meters of the roadway.

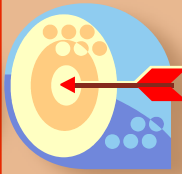
Issue: Student exposures to MSATs.



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# Assess Issues of Concern (cont.)

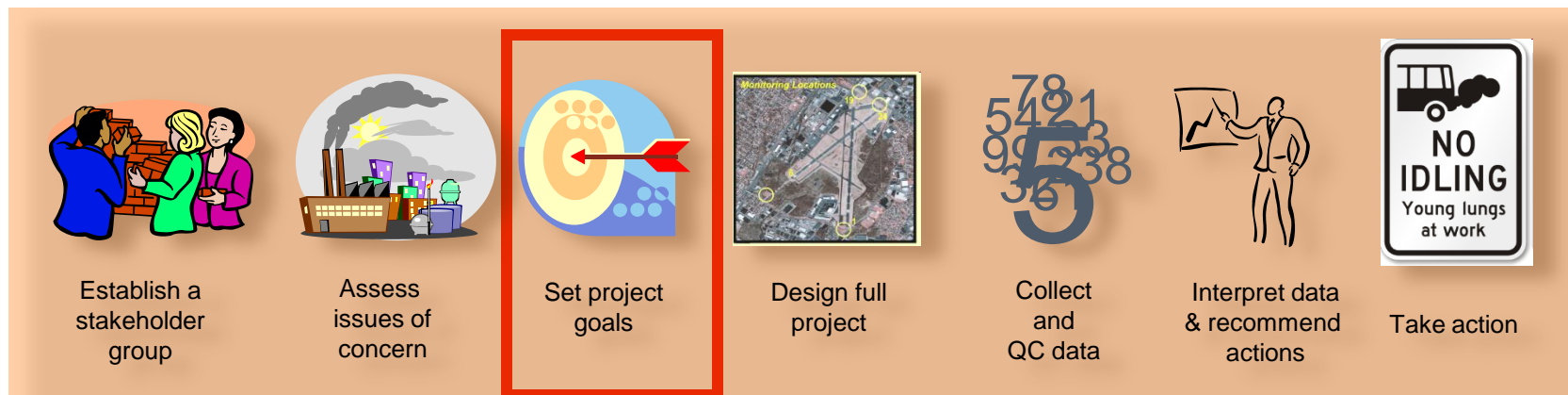
Western High School

Fyfe Elementary School



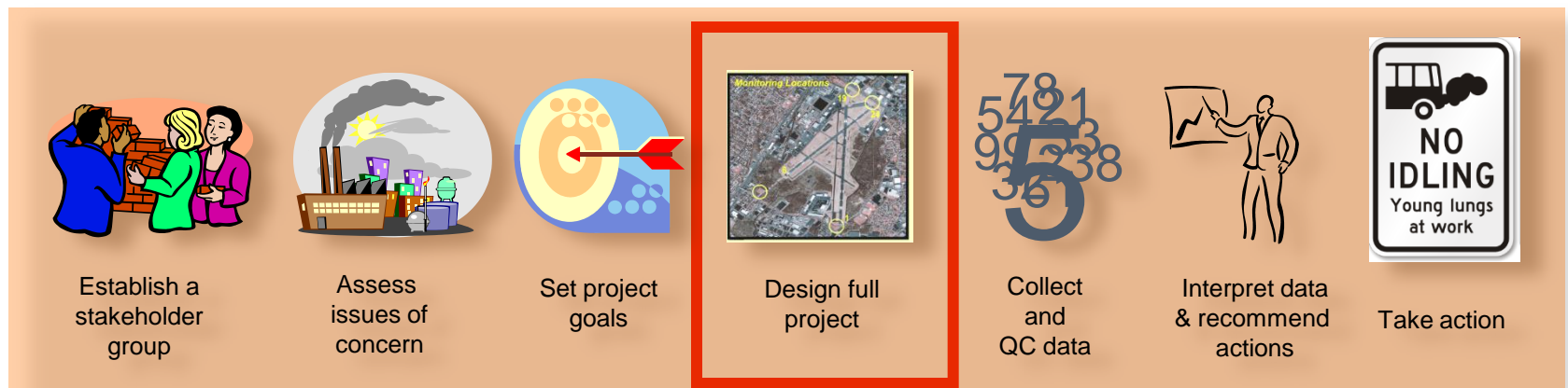
# Set Project Goals

- Characterize outdoor and indoor concentrations of MSATs at three schools, and thus characterize students' exposure to MSATs at the schools.
- Determine the contribution of vehicle traffic on US 95 to students' exposure.
- Determine the effectiveness and MSAT removal efficiencies of air management systems to be installed at each school.



# Design Project: Pollutants of Interest

- Six MSATs from settlement agreement
  - Diesel particulate matter (DPM)
  - Diesel exhaust organic gases (DEOG), specifically benzene, 1,3-butadiene, acrolein
  - formaldehyde, acetaldehyde
- Other pollutants to help determine US 95 contributions:
  - Carbon monoxide (CO), nitrogen oxide (NO), nitrogen dioxide (NO<sub>2</sub>)



# Design Project: Critical Issues

- Measurement methods
- Measurement siting issues
- Meteorological data issues
- Informational and logistical needs (Clark County School District)
- Traffic data needs (NDOT)
- Measurement strategy issues
- Additional critical issues



# Design Project: Monitoring for DPM

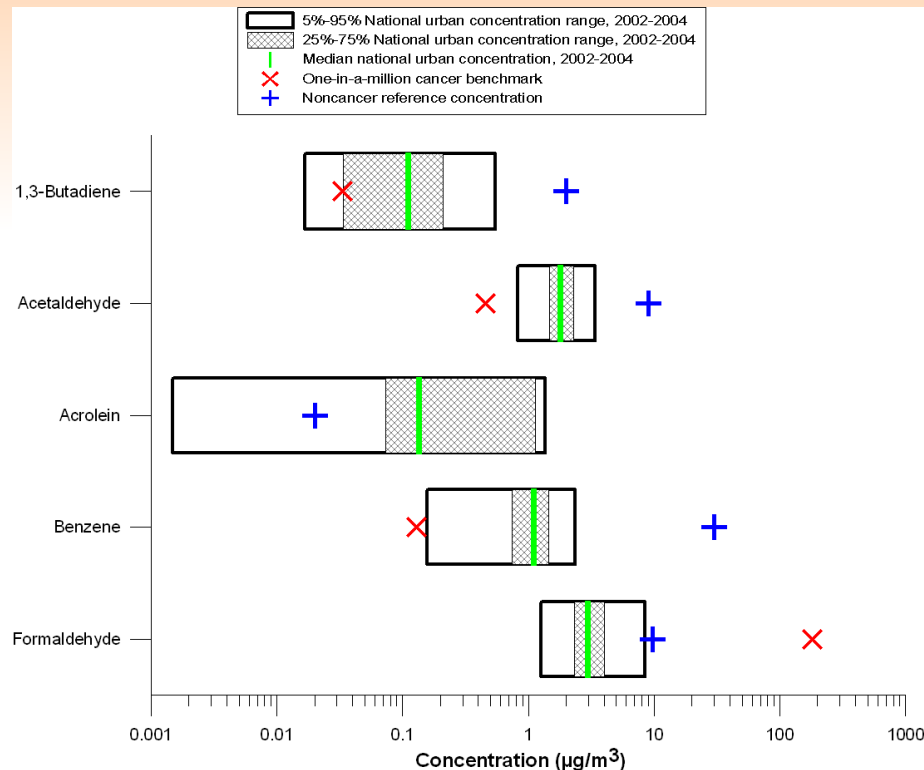
- No current reference or standard method for DPM
- Two potential surrogate methods:
  - Particulate-PAH; correlates with 4- & 5-ring PAHs
  - Black carbon ([BC], at 2 wavelengths, BC and UV)
  - Both methods can operate at about 10-minute and 1-hr frequency.
- Also use species ratios (to CO, NO, and NO<sub>2</sub>, but at fewer sites?)

**Example of Collected Filter**



PM collected on 1" wide filter tape; note different degrees of black.

# Monitoring for Gaseous MSATs



- Background concentrations
- Method detection limit
- Range of expected concentrations

- Benzene, 1,3-butadiene, and acrolein can be measured using canister sampling and analysis (EPA method TO-15).
- Formaldehyde and acetaldehyde can be measured using DNPH cartridge samples and HPLC/UV absorption analysis (EPA method TO-11).
- These methods and expected concentrations away from roadway likely require 1-hr or longer samples.

# Design Project: Monitoring Locations

- How many are needed outdoors at each school?
  - Cost will restrict this.
- Where should they be placed?
  - Likely at playground/sports fields; also, near air inlets of classrooms.
- What is the influence of sound walls?



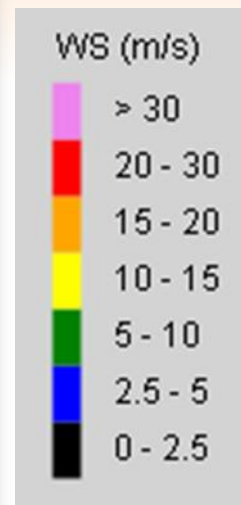
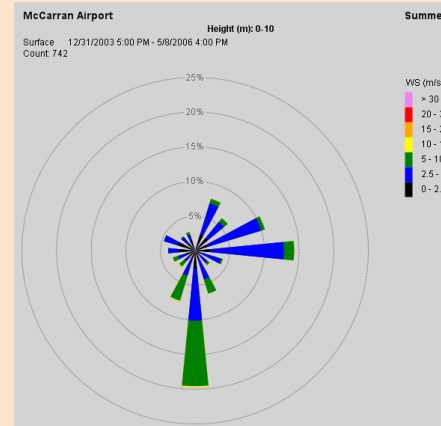
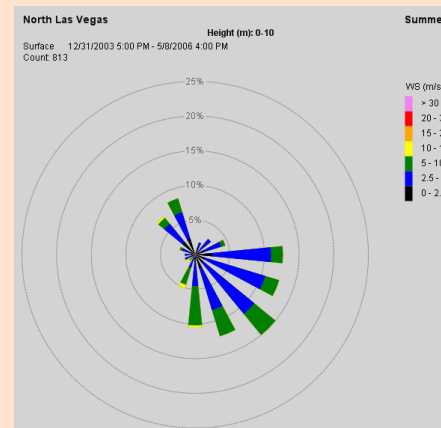
View from roof of science building at Western High School; monitoring trailer and US 95 in foreground

# Wind Directions Are Different at Existing Sites North and Southeast of Schools

Average Wind Speed  
and Direction  
7 AM to 2 PM

North Las  
Vegas Air  
Terminal

McCarran  
International  
Airport



Winter

Summer

**So we'd better measure winds at the study sites!**



# Design Project: School District Information and Logistics

- School calendar details for 2006–2007 and 2007–2008 years
- When and where for installation of air management systems; also, operational characteristics (on/off times, days, changes, etc.)
- Bus operations (location, timing, frequency, changes, etc.)
- Guidance on outdoor locations that would be acceptable (and not acceptable)
- Need for space, power, phone/Internet, safety, security, access
- Need to be creative for indoor locations (space, noise, classroom disruption)
- Opportunities for community education and outreach, and for science instruction in the classroom?

# Measurements Issues: Outdoor

- “Exposure” objective could be met with average samples (up to a complete school day).
- “Removal efficiency” objective could also be met with average samples.
- However, in order to meet “contribution” objective, changes in atmospheric and traffic conditions and in student activities require shorter averaging times.
- Thus, a combination of continuous and average samples are likely required.

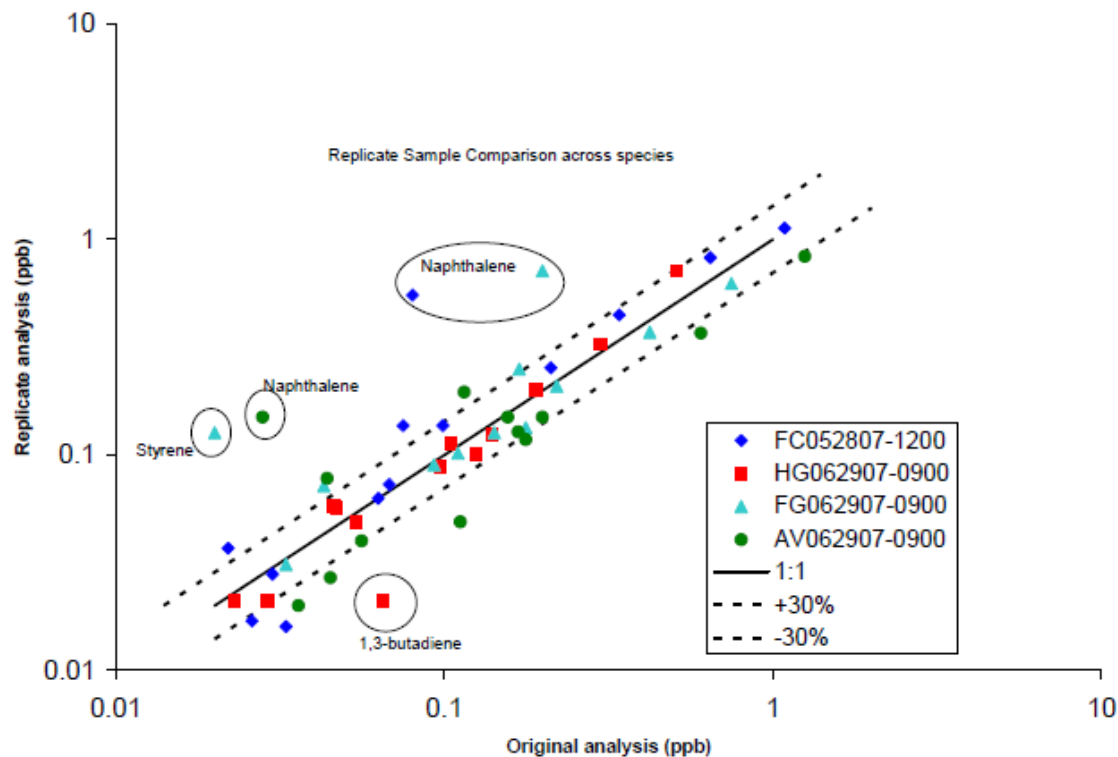


# Measurements Issues: Indoor

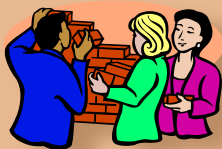
- Need classrooms “in operation”
- Represent indoor concentrations before and after air management system installation and operation (if possible)
- Consider realistic ranges of ventilation, including seasonal variations
- Possibly deploy at one routine indoor location and perform multi-location indoor intensives, possibly rotating to the three schools
- Recognize difficult logistics inside classrooms (noise, space, disruption)



# Collect and QC Data



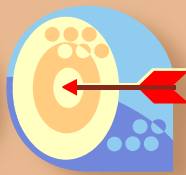
**Figure H-2.** Scatter plot comparison of four collocated samples from the summer IOP. Large outliers are circled and the pollutant identified. The lines indicate the 1:1 ratio (solid) and the 30% uncertainty (dotted) range.



Establish a stakeholder group



Assess issues of concern



Set project goals



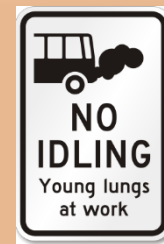
Design full project



Collect and QC data



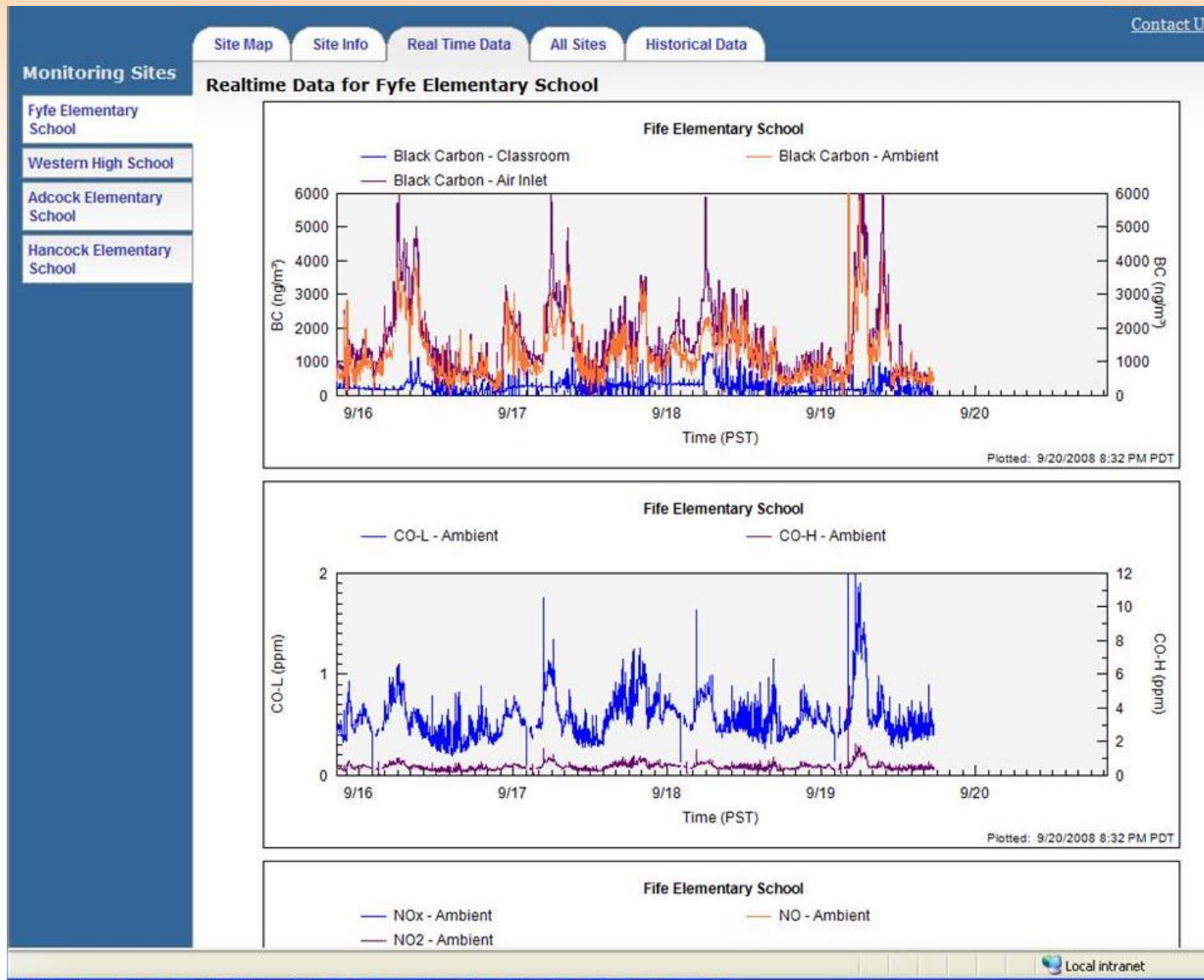
Interpret data & recommend actions



Take action

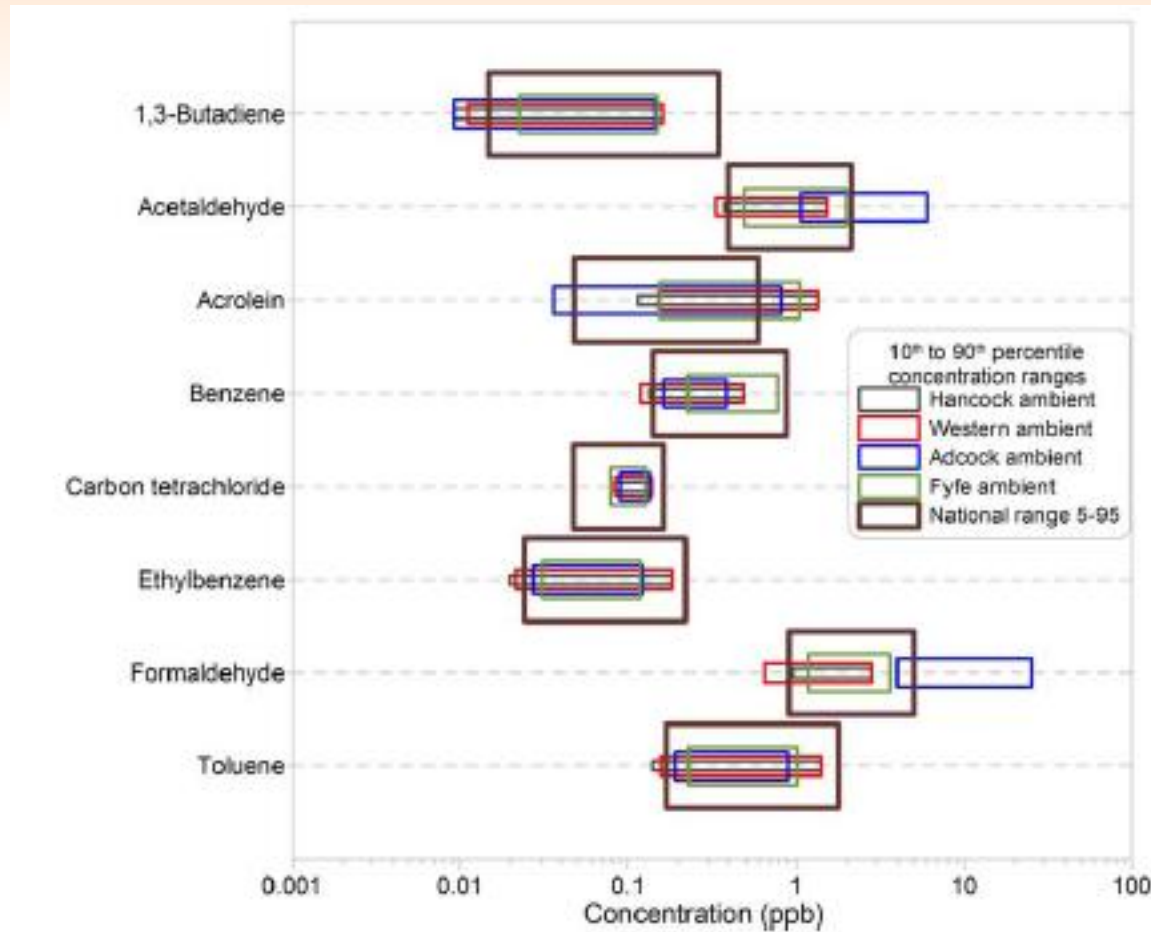


# Collect and QC Data (cont.)



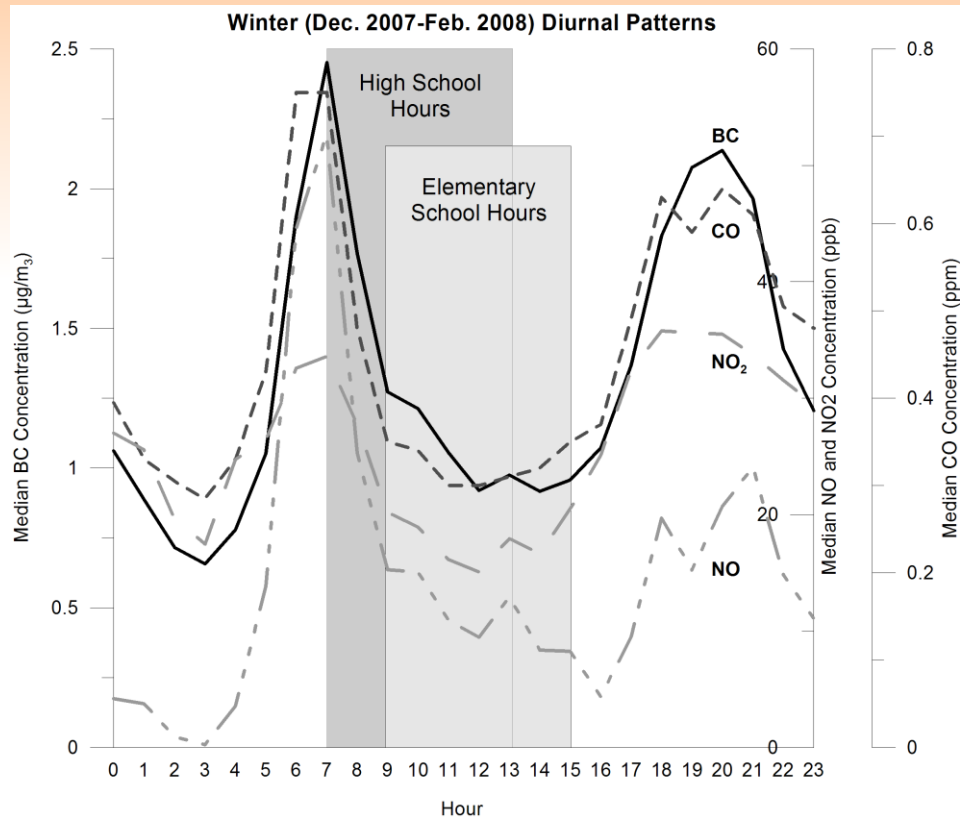
# Collect and QC Data (cont.)

Level 3 validation – comparisons with national data ranges

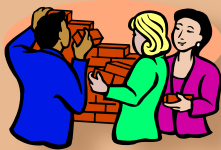


Selected MSAT concentration ranges at each school during both intensive operating periods and the national ranges during 2003–2005 (5<sup>th</sup> to 95<sup>th</sup> percentiles) (McCarthy et al., 2009).

# Interpret Data and Recommend Actions



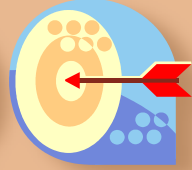
- Diurnal pattern is important for school day exposures
- Potential option for mitigation of exposure is to change hours of operation for high school



Establish a stakeholder group



Assess issues of concern



Set project goals



Design full project



Collect and QC data

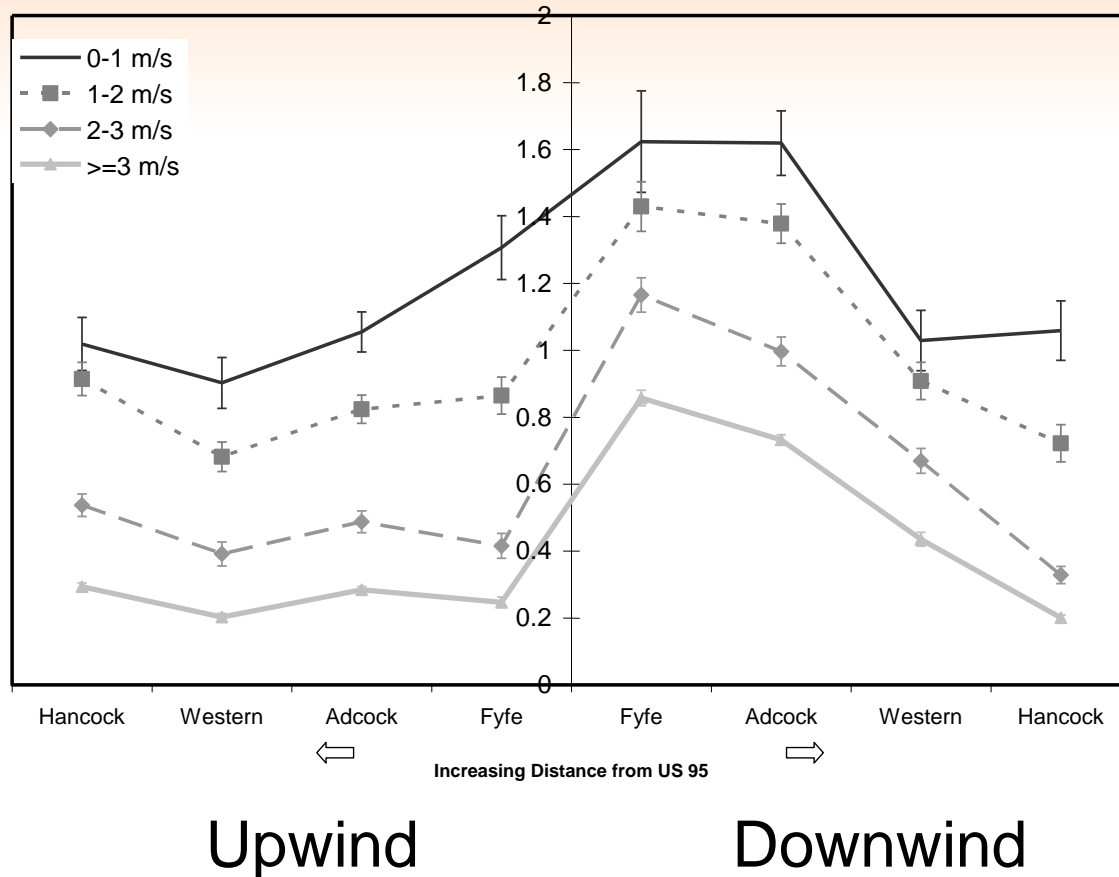


Interpret data & recommend actions



Take action

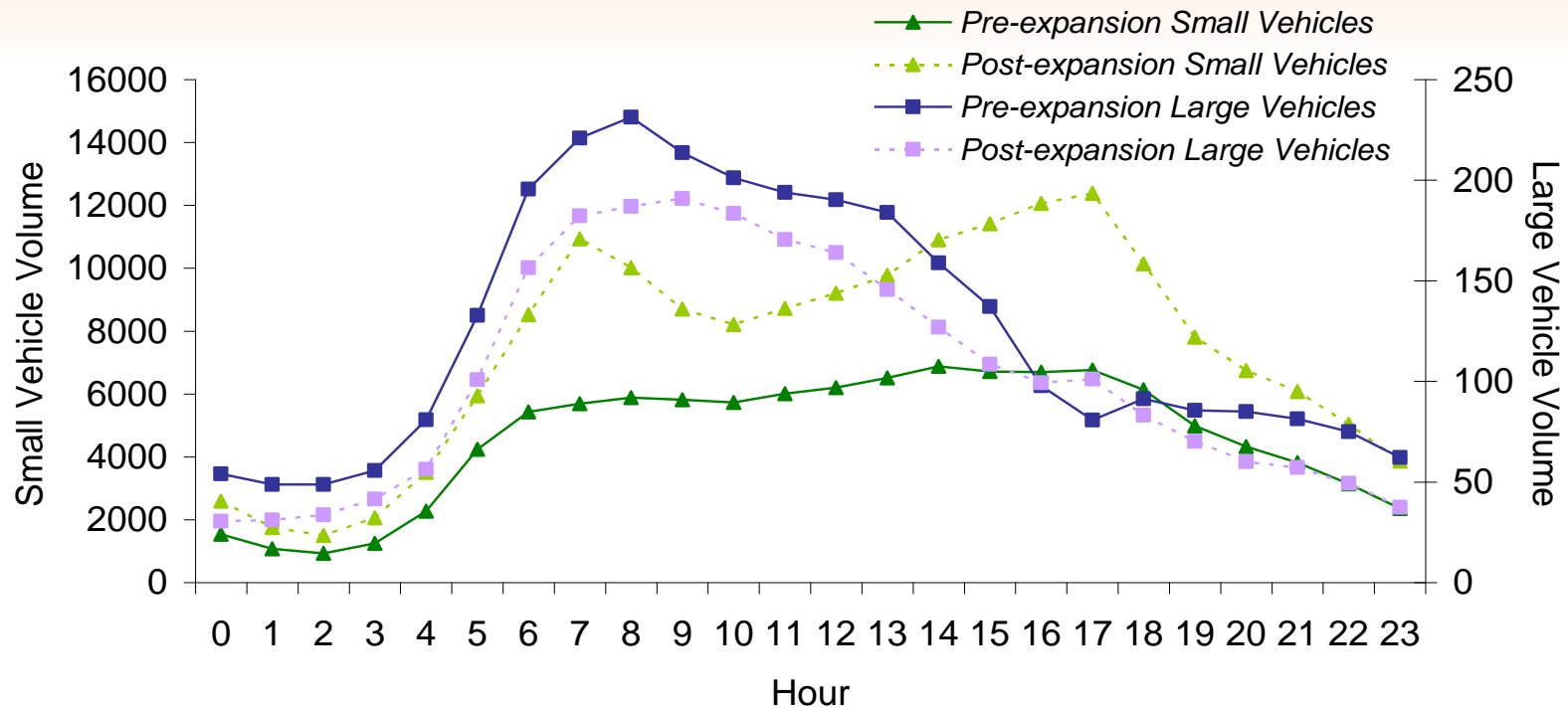
# Gradient in Concentrations is Influenced by Wind Speeds



- Near-road school concentrations were higher when winds were from the road
- Near-road school concentrations were 2 to 3 times higher than upwind school concentrations
- Concentrations are greatest when winds are lowest

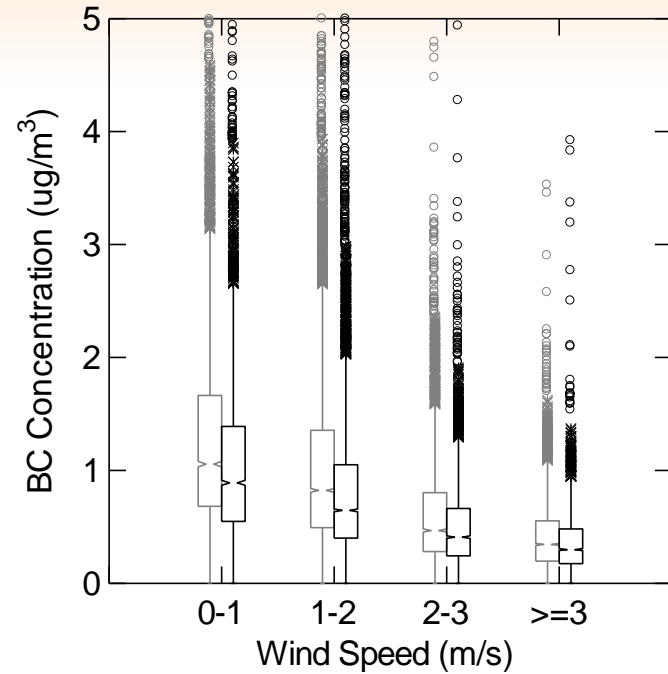
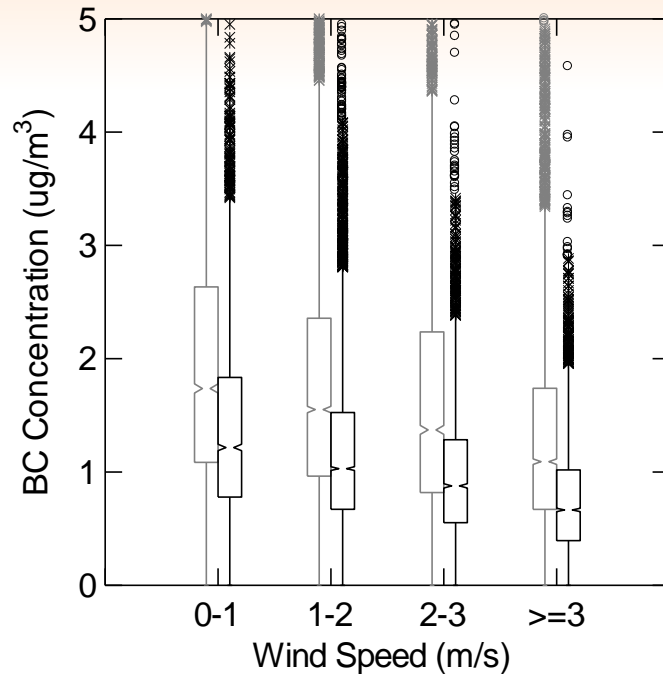


# Small Vehicle Traffic Up ~62% and Large Vehicle Traffic Down ~17% After Expansion



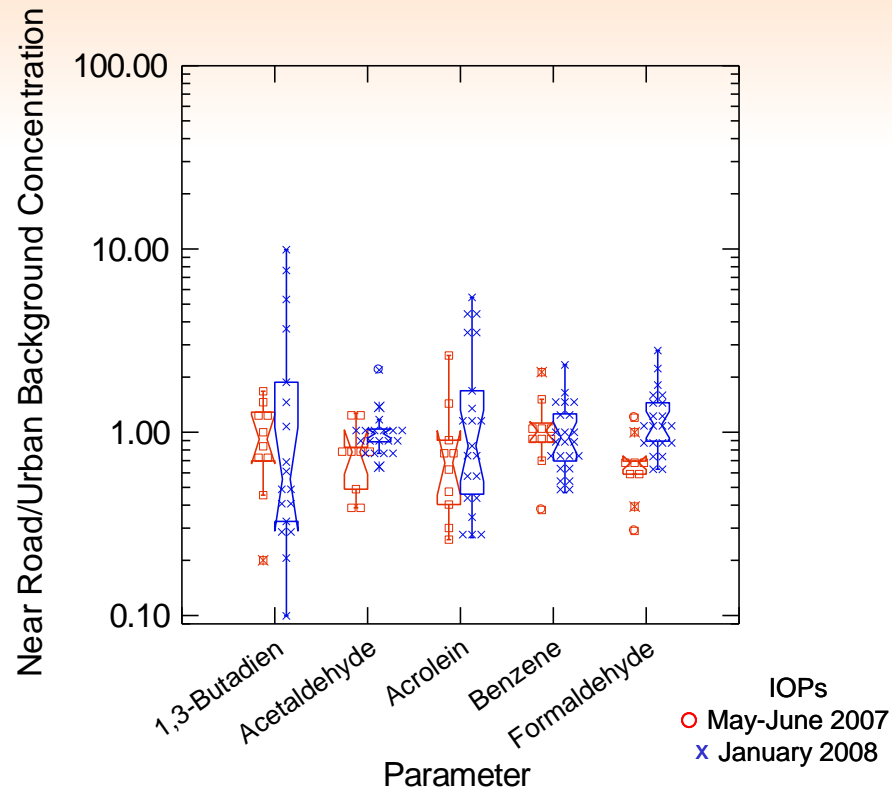
Average hourly weekday volumes for small vehicles (less than 21 feet in length) and large vehicles (greater than 40 feet in length) pre-expansion (June–August 2007) and post-expansion (June–August 2008).

# Black Carbon Concentrations Are Down After US 95 Expansion



Pre-expansion (summer 2007, gray) and post-expansion (summer 2008, black) concentrations for Fyfe (left) and Hancock (right) on weekdays.

# Gaseous MSAT Concentrations Before and After US 95 Expansion

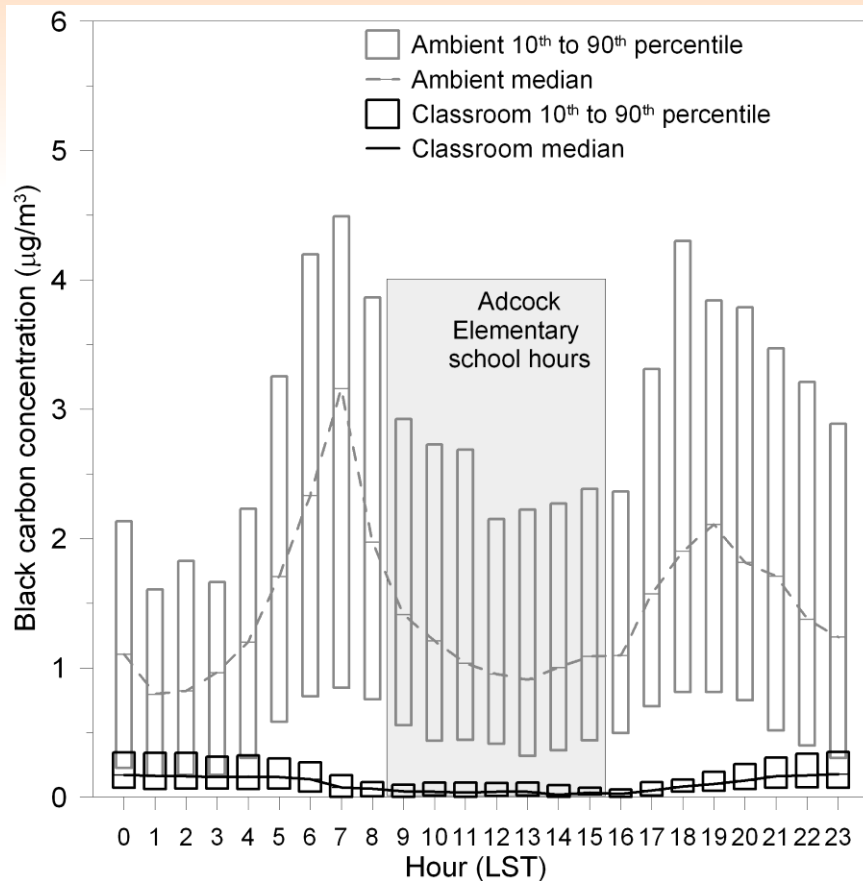


2-hr. integrated samples at 9–11AM and 1–3 PM on 14 days in 2007 and 14 days in 2008.

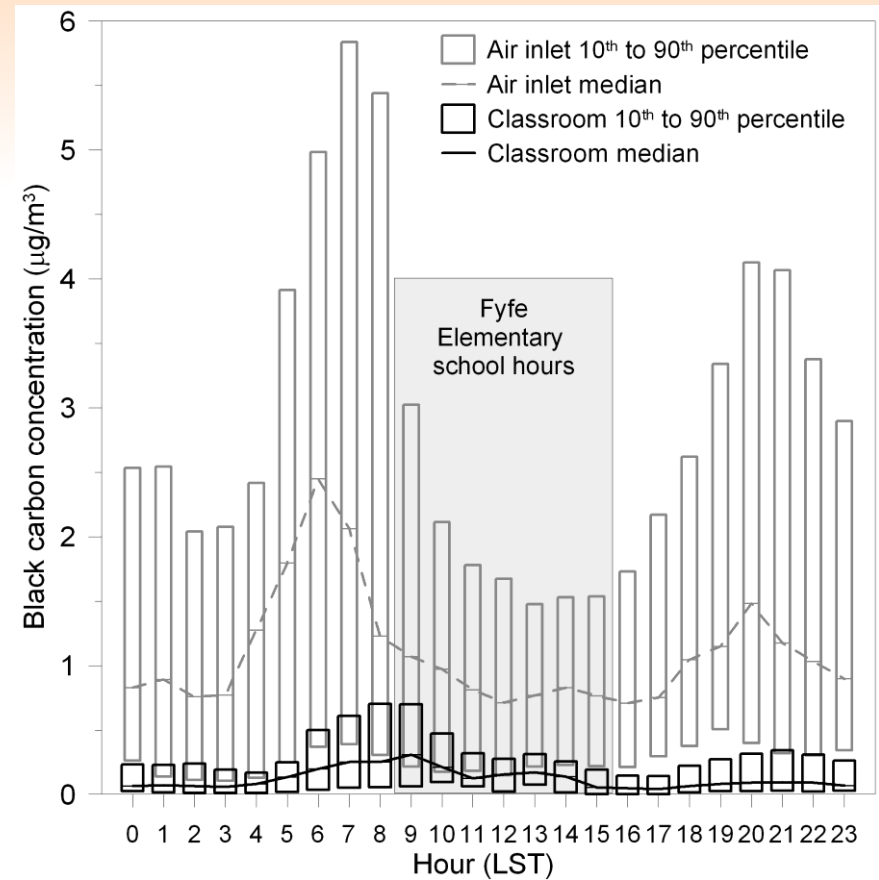
Too few samples to identify significant differences.

Pre-expansion (May–June 2007, red) and post-expansion (January 2008, blue) concentration ratios for Fyfe/Hancock.

# BC Distributions Outdoors and in a Classroom: Significant BC Removal



Effective filter efficiency: original system about 74%; improved system about 97%.

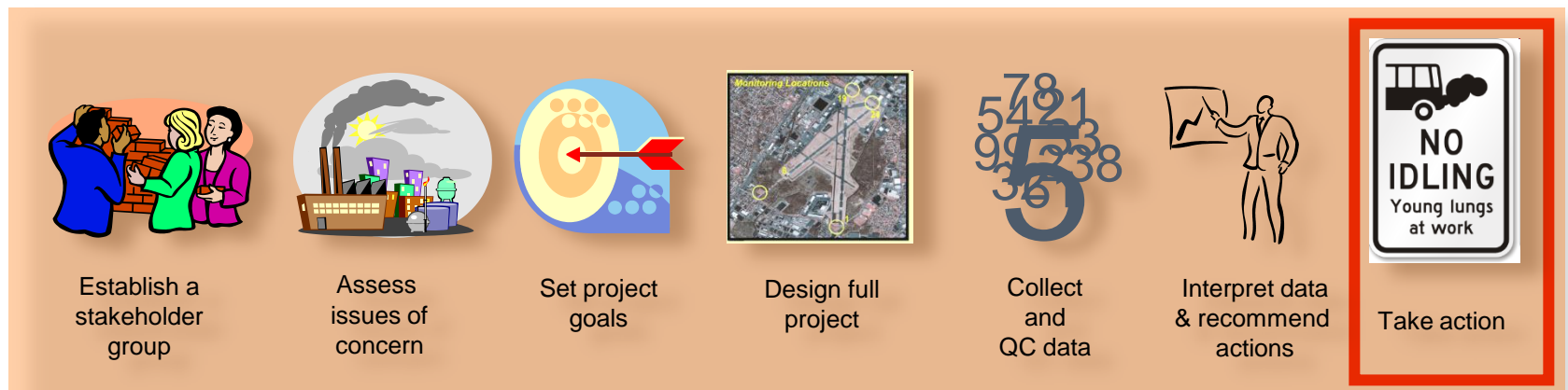


Effective filter efficiency: original system about 61%; improved system about 78%.

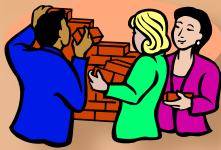


# Take Action

- Filtration system installation at near-road schools
- Behavior modification
  - Leave doors/windows closed in classrooms that have doors to the outside
  - Avoid early morning recess/gym class near roads
  - Change timing of HVAC system operations to avoid early morning intake of air
  - Implement bus anti-idling measures



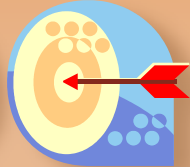
# Wrap Up



Establish a  
stakeholder  
group



Assess  
issues of  
concern



Set project  
goals



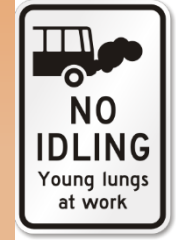
Design full  
project



Collect  
and  
QC data



Interpret data  
& recommend  
actions



Take action

- Resources and references
- Evaluation forms

# Resources and References

- Resources are available at <http://www.epa.gov/ttn/amtic/toxdat.html>
  - Presentations made on air toxics studies conducted by EPA, tribal, state, and local organizations.
  - Air Toxics Data Analysis Workbook and Training Presentations and Webinars.
- References for citations in this training session are provided in the Air Toxics Data Analysis Workbook